

dream of growing the trees far apart. Pruning off the large branches of isolated pines, which Des Cars says can be safely reduced to half or one-third of their length, provided foliage branches are left above the section to draw up the sap, will not improve the timber of these trees; nor certainly, as Des Cars says, render them fit for masts and spars, which can only be obtained from the densely-planted and slowly-grown pine-forests of Northern Europe.

To return to the treatment proposed for oak trees: Des Cars will not persuade foresters that large living branches can be pruned off without danger to the future quality of the timber, however carefully the operation may be performed. It is safer to restrict pruning, in the case of oak, to dead or dying branches, or to branches still too young to contain any heart-wood, and which therefore heal up speedily. Broillard, one of the best of French foresters, who has recently written an excellent book¹ on forest management in France, praises the hedgerow oaks of England especially because they are left with their natural crowns intact. If oaks are to be trained, it should be done whilst they are young. Having premised the danger of too great enthusiasm for pruning on the part of inexperienced persons, there can be no doubt that it may sometimes be necessary to prune large branches of neglected roadside avenue trees, which, however, should have been done whilst they were still only formed of sap-wood; and in such cases, and in all cases of pruning small branches, Des Cars is an excellent guide, and thoroughly explains how the pruning should be effected, his main ideas being to prune close to the stem, and in merely shortening branches to leave a sap-lifter above the wound, to maintain life in the shortened branch. Finally, all wounds should be dressed with coal-tar. For carrying out the work, De Courval's strong heavy pruning hatchet is recommended, and the use of the saw deprecated, as requiring much practice to use skilfully; but it is better only to employ skilful woodmen to prune trees, and then the saw is generally the better instrument to use.

"Webster's Practical Forestry" is another useful little book, giving the experience of a practical man who has devoted his lifetime to the every-day duties of a forester. It is not, however, by any means an exhaustive treatise, and, curiously enough, not a word is said about pruning; but the author wisely advises that wherever trees are grown for their economic value, they should be kept close with an unbroken leaf-canopy, so that the lower branches may be killed outright for fully one-half the length of the stems.

Nothing is said about coppice or coppice with standards, which are the commonest modes of growing woods in England.

The efficacy of drainage on forest growth is too much insisted on, while the opinion of French foresters on moisture in the soil may be summarised as follows from Broillard's book, already quoted:—

Dry lands will only produce timber under dense growth of shady trees, which keeps the soil somewhat moist in summer.

Soils which in summer never dry below 6–8 inches

allow most forest species to thrive. Moist soils, which when pressed in the hand always leave some trace of moisture, are the most fertile, and suit the pedunculate oak, the ash, and the elm.

Wet soils, usually saturated with water, provided the latter is in movement, and therefore aerated, as along the banks of watercourses, suit alders, willows, and poplars.

Marshes are usually unproductive, but they afford moisture to neighbouring lands, and fine trees are found along their borders. Thus drainage is only required where there is not enough fall of the ground for the water to move about, and, provided the water does not stagnate the roots of forest trees are the best drainers of a soil.

Webster gives some useful notes on trees adapted for various soils and for town planting, and ranks the maiden-hair tree (*Ginkgo biloba*) and *Ailanthus glandulosa* next to the plane as trees flourishing in spite of the smoke of large cities. He also gives an excellent list of trees adapted to grow exposed to sea-breezes, of which *Pinus Laricio* is the best among conifers, and Norway maple and sycamore among broad-leaved trees. The larch, it appears, when grown on gravel generally becomes rotten at the core, and Webster's advice to study the relationship of trees and soils is greatly needed in England, where it is frequently the practice to plant alternate lines of spruce, Scotch pine, larch, and beech without any regard to the different demands they make on the soil. His complaint of preferential railway rates to foreign growers, which have rendered osier-beds unremunerative, points to a great obstacle to forestry in the United Kingdom. An Irish land-agent recently said that it was impossible to send wood from the interior to the ports at a profit; and if our railways cannot provide cheap goods carriage, it is time that canal extension on a large scale were proposed for the transport of our heavy country produce, and that existing canals were withdrawn from the control of the railway companies.

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RECENT RESEARCHES ON SACCHAROMYCETES.

Micro-Organisms and Fermentation. By Alfred Jørgensen (Copenhagen). Translated from the third edition in German by A. K. Miller and E. A. Lennholm, and revised by the author. (London: F. W. Lyon, 1893.)

THE development of bacteriology is closely linked together with the advances made in our knowledge of fermentation, which was first placed on a truly scientific basis through the far-reaching investigations of Louis Pasteur in his "Études sur la bière." He propounded the doctrine that every fermentation and putrefaction is caused by micro-organisms. This is an accepted theory now, if by fermentation we understand alcoholic fermentation. For there are other processes of fermentation which are produced by unorganised substances, whose chemical nature is as yet undefinable, such as ptyalin, pepsin, trypsin. The part played by micro-organisms as ferments in disease is still shrouded in mystery. At one time it was thought that they produce a specific lesion by means of basic bodies allied to the vegetable alkaloids, but differing from them in chemical composition and

¹ "Le traitement des bois en France," par Ch. Broillard, ancien professeur à l'école forestière. (Paris: Berger Levrault et Cie, 1894.)

reactions, to which the name "ptomaines" was given, and which were carefully investigated by Brieger. When Hankin discovered an albumose amongst the metabolic products of anthrax bacilli, the ptomaines were regarded with suspicion, and toxalbumins in the form of albumoses, peptones, globulins, separated from artificial cultures of pathogenic bacteria, and pronounced to be the true toxins. The fact that in snake venom and some vegetable poisons, such as abrin and ricin, similar toxalbumins were obtained, lent still further interest to the whole question, and our path seemed perfectly clear. Duclaux, of Paris, at all times raised objections of great weight against this conception of toxalbumins, and the recent works of Buchner, Sidney Martin, and others tend to show that the toxins of most pathogenic micro-organisms are ferment-like bodies, not reacting as ordinary albumoses, peptones, globulins, or albumins when the germs are grown in non-albuminous substances.

Dr. Jörgensen's work discusses the phenomena of alcoholic fermentation only and especially as applied to the brewing of beer, and does not give a general account of fermentation in all its aspects, physiological or pathological, as we had hoped from the title of the book. The Danish savant is, however, hardly responsible for the slight disappointment which we experienced on finding that the scope of the book, which numbers over 250 pages, is limited to alcoholic fermentation, for the German word "Gährung" is generally used to signify this special kind of fermentation. Though this book appeals in the first instance to scientific brewers, and none the less to practical ones, it contains much of special interest to the biologist, bacteriologist, and chemist. The greatest merit is the collection and summary of Hansen's work on yeasts, and we must be grateful to the translators for having given us the results of the patient and laborious investigations made at the Carlsberg Laboratory in an English rendering. Hansen cleared the hopeless confusion existing regarding the saccharomycetes by finding methods for obtaining pure cultures and separating and distinguishing various allied forms which, though hitherto included under the same name, were mere impurities. He rendered a great service to botany and biology by giving an accurate description of the sporulation of these organisms, their various forms of spores, and their germination, facts which enabled him to differentiate between various groups of saccharomycetes. Amongst the latter only organisms are found capable of rapidly and vigorously fermenting maltose, and the yeasts for breweries and distilleries must therefore be sought among them, and a suitable species must always be selected for each particular kind of beer. Hansen studied also and discovered groups of wild yeasts which produce diseases in beer, such as bitter taste and turbidity, and he showed that these unwelcome guests are capable of doing harm only when introduced into the wort at the commencement of fermentation. He has also pointed out ways and means to avoid and prevent disease in beer. Dr. Jörgensen carefully describes the various species and varieties of saccharomycetes and torulæ, and a point of special interest is the tendency of many among them to form mycelia or pro-mycelia, a tendency which by Klein and others has also been observed in schizomycetes, such as diphtheria, tubercle, and

anthrax bacilli. For industrial purposes absolutely pure and carefully selected yeast cultures should be used for brewing. This is already done by many breweries on the continent and in America. In England, however, we are slow in applying scientific research to industrial pursuits, and though a number of breweries already use Hansen's system, it can hardly be said that it has received the attention it deserves, and chance, tradition, and blind empiricism still govern too much the manufacture of beer in England. As Prof. P. Frankland says: "Scientific accuracy and the certainty of success can only be introduced into the industry of brewing with a due appreciation of these brilliant researches."

Dr. Jörgensen has treated his subject in a thoroughly scientific and withal clear and concise manner, which suffers but little, if at all, from the translation. To brewers and those interested in the mycotic chemistry of brewing, the book will be welcome, and to those who are not able to read the works of Hansen in the language in which they have been written, it will be invaluable. We hope that this work will assist in banishing empiricism from the English systems of beer fermentation. The general application of Hansen's method is merely a question of time.

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OUR BOOK SHELF.

A Year amongst the Persians. Impressions as to the Life, Character, and Thought of the People of Persia, received during twelve months' residence in that country in the years 1887-8. By Edward G. Browne, M.A., M.B., Lecturer in Persian to the University of Cambridge (London: A. and C. Black, 1893.)

MR. BROWNE'S studies lie in the realms of metaphysics and linguistics, subjects which appeal readily to the cultured Persians of the cities. Hence he has obtained more insight into the intellectual side of Persian life than falls to the lot of most foreigners visiting the Shah's dominions. His sympathies are wide, and his tact considerable, for he succeeded in winning the confidence of the persecuted Bâbis and down-trodden *Guebres* of Shiraz and Yezd without incurring the enmity of the official classes. The story of these people and their beliefs is admirably told, but from its nature it lies outside the scope of critical consideration in this journal. Amongst the *Guebres* or Zoroastrians of Yezd Mr. Browne recognised the most perfect representatives of the ancient Persian race, the physical type being kept pure by the unceasing persecution to which the sect has been subjected since the commencement of Moham-medan supremacy. These people are in constant communication with their kinsmen the well-to-do Parsis of Bombay, who occasionally revisit the country of their origin. The glimpses of the habits and customs of Persian life and thought are singularly vivid, and although the author rather avoids mere topographical detail, his brief sketches of the cities in which he sojourned are powerfully drawn and strikingly accurate. The great want of the country appears to be irrigation, which is carried on at present very partially and in a wasteful manner. Near Kashan a stream was found carefully dammed at intervals to cause the water to overflow the bank and trickle into the channel below heavily charged with mud, the reason assigned being that muddy water evaporates less rapidly than clear.

While the book is generally free from error, we note a slip, hardly to be expected of a Cambridge graduate, on p. 463, where he speaks of a hole a yard square, when the